



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

SOME RECENT STUDIES ON FOSSIL AMPHIBIA

DR. ROY L. MOODIE

DEPARTMENT OF ANATOMY, UNIVERSITY OF ILLINOIS, CHICAGO

THE anatomy and relationships of the earliest air-breathing vertebrates have interested students of fossil animals so greatly since Georg Jaeger described the first Labyrinthodont in 1828, that the result to-day is a bibliographic list of over 600 titles, varying in importance from the magnificent work of Fritsch ("Fauna der Gaskohle") issued in four folio volumes with scores of lithographic plates, to short notices of a few lines. Many of the memoirs are handsomely illustrated and beautifully printed. The material so far described has been extremely fragmentary and the greater number of the contributions issued have been dedicated to the description of species based on incomplete material. The fauna was exceedingly diverse like the plesiosaurs of a later period, and new discoveries tend to confuse rather than to unify our ideas of amphibian morphology. The few papers reviewed below form no exception to the statement made above. Many new and important facts are brought forth in the contributions made during the past few months and these are well worthy of consideration. Attention in these reviews will be paid especially to new facts of structural importance.

Broili (1) in a short paper has added to our knowledge of the Permian fauna of Texas by the description of two new species of Amphibia based on incomplete skulls. One of the species is very small, the skull measuring scarcely half an inch in length. The same writer (2) in a more extensive paper has given a popular review of the chief work done during the past ten years on the early air-breathing vertebrates and has listed the important papers from which he has used illustrations to elucidate his remarks. This paper should be consulted by any one who wishes a convenient and accurate survey of the earliest land vertebrates. Doctor Broili refers to *Micrerpeton*, the first branchiosaur known from the western hemi-

sphere, as a microsaur. The distinction between these two groups is clear, the former undoubtedly being ancestral to the modern Caudata and the latter having reptilian affinities. Likewise the author refers to *Lysorophus*¹ as a reptile, while the majority of paleontologists regard the form as Amphibian; Williston¹ even going so far as to locate it in the suborder Ichthyoidea of the Caudata. In conclusion Doctor Broili says:

Im übrigen haben wir im Laufe der letzten 10 Jahre über die ältesten Tetrapoden so viel neues und wichtiges kennen gelernt, wie wohl in relativ keinem anderen Zweige der Wirbeltierpaläontologie. . . .

Broom (3) has given the results of his studies on Permian vertebrates in the American Museum. His reason for again describing and studying this much described and much studied material is that structural characters are difficult to determine in these forms on account of the very closely adherent matrix which has in many cases obscured all sutures in the skull. His discussion is accompanied by restorations of the skulls of the chief Permian genera, indicating most of the sutures, something which Cope was unable to do. He discusses some elements in the mandible not previously observed among Amphibia and suggests homologies between them and elements of the reptilian mandible. Unfortunately, Broom has paid no attention to the occurrence of lateral line canals on the skulls of these forms. It is highly important that this system of sense organs be distinctly understood. In view of Herrick's studies² on this structure in the catfish it is certain that this system of sensory organs has a distinct influence on the location of the peripheral osseous elements of the skull and mandible. I do not recall that Herrick's result have been noted by any paleontologist, but they should be taken into consideration. Broom says in regard to *Eryops*, the large Permian stegocephalian:

. . . Every detail of the cranial structure can be clearly made out.

He criticizes Huene's (1913 *b*) work on the brain-case, however, and makes no statement concerning the lateral

¹ *Biol. Bull.*, Vol. XV, No. 5, p. 229, 1908.

² *Journ. Comp. Neurol.*, Vol. 11, p. 224, 1901.

line organs which were imperfectly studied some years ago³ by the reviewer; so it is yet too soon to say that every detail of structure is known. The palate is very completely known and is figured by Broom. He has figured also very imperfectly, but for the first time, sections through the ear and brain-case showing the probable size of the dural cavity. He says that the portion of the paroccipital which lodges the labyrinth was cartilaginous, but does not give his reasons for this statement. In view of the almost perfect preservation of the semicircular canals in fishes, cotylosaurs and pterodactyls we should expect a favorably preserved specimen of an amphibian to show this structure also. He describes a pit in the basisphenoid for the reception of the hypophysis. He also figures for the first time the complete osteology of the mandible of *Eryops*. The author likewise describes and briefly figures two new species of stegocephalians. The same author (4) has given considerable attention to the study of the osteology of the mandible in *Trimeorohachis*, the discussion being very similar to that given in the above paper. The discussion has especially in view the problem of the derivation of the Amphibia from the Crossopterygia, and he figures the mandible, shoulder girdle and pectoral fin of *Sauripteris taylori* on account:

. . . of (the) extreme interest from having the pectoral fin more closely resembling the tetrapod limb than in any other known form.

Case (5) reviewed before the American Paleontological Society the recent trend of studies on the air-breathing vertebrates of the Paleozoic. He states there are two general conclusions which have been reached by students of these early vertebrates. First, Baur initiated the idea of the crossopterygian ancestry of the Amphibia, and later workers have so far confirmed his suggestion as to make it extremely probably that the land vertebrates arose from these fishes. The intermediate stages are unknown. The second conclusion is

that the primitive reptiles—the Cotylosauria—were derived directly from the Stegocephalia. . . .

So we are thus in possession of partial proof at least of

³ *Journ. Morphol.*, 1908, Vol. XIX, p. 511.

the origin of reptiles from fishes through the Amphibia.

We owe to Doctor Fraas of Stuttgart many important contributions to the knowledge of the early air-breathing vertebrates and he has recently (6) issued another memoir on the labyrinthodonts of the Trias, the first study of these animals since the appearance of his large memoir in 1889.⁴ The present contribution is devoted to discussions of new species and new facts concerning previously described species. The *Plagiosternum granulosum* is found to be the most peculiar labyrinthodont yet described, in that it is extremely frog-like in appearance, especially in the huge size of the orbits and the expanded occiput. It is interesting, furthermore, in the apparent absence or indistinct preservation of the lateral line canals. The photograph (Plate XVI, Fig. 1) of the dorsum shows portions of the supra- and infraorbital canals. The remainder of the cephalic system of sense organs was probably contained in pits, which, in the fossilized skull, are not to be distinguished from the ornamental scrobiculations of the membrane bones of the face. The auditory meatus is on the posterior edge of the skull and is quite large for the size of the skull. Doctor Fraas has given in a drawing (Plate XVI, Fig. 3) the complete osteology of the occiput of this unusual labyrinthodont. The remainder of the memoir is devoted to a discussion of new or disputed points in the osteology of various genera and species of Triassic labyrinthodonts.

Gregory (7) has reviewed the studies which have thrown light on the crossopterygian ancestry of the Amphibia, dealing especially with Watson's (11) recent paper on the Larger Coal Measures Amphibia, and giving a list of thirteen contributions which deal directly with this derivation of the Amphibia.

Huene (8) has again described the mandible of the peculiar Permian genus *Diplocaulus* although it has been many times studied, described and figured. He states, in his introductory paragraph:

Gattungen, wie *Diceratosaurus*, *Eoserpeton*, *Stegops*, *Amphibamus*, vielleicht auch *Tuditonus* zeigen Verwandtschaft mit *Diplocaulus*.

⁴ "Paleontographica," Bd. XXXVI.

Just what the basis of this relationship is he does not state. The reviewer⁵ has previously stated that these above-mentioned microsaurian genera exhibit *no* structural features which would ally them, except remotely, with *Diplocaulus*. This Permian genus has no relatives among the Coal Measures Microsauria, the reasons for this statement being given in the above-mentioned essay⁵ and need not be repeated here. The material on which von Huene bases his paper was collected in Baylor County, Texas, and formed a part of a collection purchased by Doctor von Huene from Charles Sternberg at Lawrence, Kansas. The same writer (9) has again studied the Permian *Lysorophus*, which is regarded by Williston as closely akin to the salamanders.⁶ Huene bases his discussion on twenty-four skulls in the collection of the University of Tübingen. He describes and figures some minute limb bones, thus partially confirming Miss Finney's results.⁷ He agrees with Williston that *Lysorophus* is related to the Urodeles though suggesting:

Mit den Temnospondylia hat der permische Urodele Lysorophus noch grössere Ähnlichkeit als die jetzigen Urodelen. Sie liegen in der Schädelbasis und der grosseren Anzahl der hinteren Schädeldeckknochen.

The same author (10) gives the results of his studies of Permian vertebrates at the American Museum. The paper is illustrated by sketches of various skulls and parts of skulls made by the author and showing his interpretation of the elements composing the cranium of American Permian amphibians and reptiles. He describes and figures a *stapes* in a skull of *Eryops* and gives the results of his study of the brain-case of this genus. The *stapes* has a length of 4 cm. and in shape is not unlike a human clavicle. His studies of *Lysorophus*, *Gymnarthrus*, *Diplocaulus* and other genera confirm the results of previous students of these forms. He concludes his paper with a discussion of morphological results, and appends a bibliography of twenty papers.

⁵ *Journ. Morphol.*, Vol. 23, p. 31, 1912.

⁶ *Biol. Bull.*, XV, 1908, p. 229.

⁷ *Journ. Morphol.*, 23, p. 664, 1912.

Watson (11) has restudied the skulls of some of the European Carboniferous labyrinthodonts, *Loxomma*, *Pteroplax*, and *Anthracosaurus*, and compared them with the Coal Measures fish, *Megalichthys*. His results have already been reviewed by Gregory (7), so that it will only be necessary here to say that these genera approach the crossopterygian type of structure in various features. The same author (12) has redescribed an interesting microsauro in which he is able to give a very complete account of the structure of the dorsal and ventral surfaces of the skull and pectoral girdle. He compares the newly reconstructed microsaurian with *Diplocaulus* and *Ceratopterion*. It is very important that these little-known species from Europe be restudied and redescribed, so that former observations may be corrected, corroborated and extended. The status of

The classification of the smaller stegocephalian Amphibia, so abundant in the Coal Measures and Permian Rocks of Europe and North America, is in such confusion, to which some recent work has added, that it is at present only possible to proceed by reference to individual specimens which have been well described.

The reviewer finds himself in hearty accord with these statements, although he must plead guilty of having thrown some confusion into the classification of these animals in the hope that thereby order might ensue.

Doctor Williston (14) has determined the complete osteology of the mandible in the early reptiles and amphibians, working especially with the material from the Permian of America. He says:

In the structure of the mandible the amphibians are remarkably intermediate between the early reptiles and the contemporary crossopterygian fishes, differing from the latter chiefly in the reduced number of coronoids, and from the former chiefly in the possession of two additional coronoids and a splenial.

These results are corroborated by the studies of Doctor Broom on similar material, so that any doubts as to the real structure of the stegocephalian mandible are placed at rest by the results arrived at by these separate investigations.

The mandible of the primitive amphibians differs chiefly from that of the early reptiles in the division of the coronoid into three elements, or possibly four, and in the division of the splenial into two.

Wiman (15) within the past three years has become much interested in the amphibian fauna of the Trias of Spitzbergen. In the present paper he reviews the work which has been done on the structures of the occiput of seven genera of Permian and Triassic stegocephalians, figuring the anatomy of this region of a new labyrinthodont from Spitzbergen. He describes this new genus in a later contribution. In this latter paper (16) Wiman discusses the occurrence of amphibian remains in the deposits of Spitzbergen, accompanying his remarks by photographs of the bone-bearing horizons. His paper deals largely with new forms from Spitzbergen, which are illustrated in four text figures and nine photographic plates. One is at once struck, in the examination of Wiman's plates, by the clearness of preservation of the cephalic lateral line canals. The author refers to these structures as "Schleimkanäle" and gives a very careful description of their occurrence; the only writer of recent date who has done so. The term *Lyrocephalus euri* is proposed for the new genus and species.

Der Gattungsname bezieht sich auf die ausserordentlich kräftig entwickelten Schleimkanäle des Kopfes. . . .

He refers to the various canals as "Tremalkanäle," "Nasofrontalkanäle," "Temporalkanal" and "Maxillarkanal," but makes no attempt to homologize them on the basis of the work of Allis^s (1889) and the reviewer^s (1908). The lateral line canals are so unusually well preserved in *Lyrocephalus* that it is thought worth while to give an outline figure in another place of their occurrence and to homologize them on the basis of previous work. The *columella auris* is described and figured (Plate II, Figs. 4-5) in this species. It is unusually large. Other new forms are described from these interesting deposits, many of the specimens showing much of interest in a structural way. The material described is chiefly cranial, although a few thoracic plates (interclavicles), of the typical laby-

^s *Journ. Morphol.*, II, 1889, p. 463; 1908, p. 511.

rinthodont form, are described and figured. Doctor Wiman is to be congratulated on his contributions to our knowledge of these early vertebrates. His future papers will be looked for with much interest.

BIBLIOGRAPHY

1. Broili, F. 1913 *a*. Über zwei Stegocephalenreste aus dem texanischen Perm. *Neues Jahrbuch f. Mineral.*, Bd. I, Jahrgang 1913, pp. 96-100, Taf. IX.
2. — 1913. *b*. Unser Wissen über die ältesten Tetrapoden. *Fortschr. d. Naturwissenschaftl. Forschung*, herausgegeben v. Prof. Dr. E. Abderhalden-Hall. A.S., Bd. VIII, pp. 51-93, figs. 14-62.
3. Broom, R. 1913. *a*. Studies on the Permian Temnospondylous Stegocephalians of North America. *Bull. Amer. Mus. Nat. Hist.*, XXXII, Art. XXXVIII, pp. 563-595, with 21 figs.
4. — 1913. *b*. On the Structure of the Mandible in the Stegocephalia. *Anat. Anz.*, Bd. 45, No. 2/3, pp. 73-78, with 4 figs.
5. Case, E. C. 1912. Paleozoic Reptilia and Amphibia. *Bull. Geol. Soc. America*, Vol. 23, pp. 200-204.
6. Fraas, E. 1913. Neue Labyrinthodonten aus der schwäbischen Trias. *Paleontographica*, Bd. LX, pp. 275-294, pls. XVI-XXII, with text-figures 1-5.
7. Gregory, Wm. K. 1913. Crossopterygian Ancestry of the Amphibia. *Science*, N.S., Vol. XXXVII, No. 960, pp. 806-808.
8. Huene, Fr. von. 1912. Die Unterkiefer von Diplocaulus. *Anat. Anz.*, Bd. 42, No. 19, p. 472-475, Figs. 1-3.
9. — 1913. *a*. Über Lysorophus aus dem Perm von Texas. *Anat. Anz.*, Bd. 43, No. 14/15, pp. 389-396, Figs. 1-5, with bibliography.
10. — 1913. *b*. The Skull Elements of the Permian Tetrapoda in the American Museum of Natural History, New York. *Bull. Amer. Mus. Nat. Hist.*, XXXII, Art. XVIII, pp. 315-386, Figs. 1-57.
11. Watson, D. M. S. 1912. The Larger Coal Measure Amphibia. *Mem. and Proc. Manchester Lit. and Philos. Soc.*, Vol. 57, Pt. 1, Dec.
12. — 1913. Batrachiderpeton lineolatum, a Coal Measure Stegocephalian. *Proc. Lond. Zool. Soc.*, Pt. IV, pp. 949-962, with 2 plates and figures in the text. See also same author: 1913. The Early Evolution of the Amphibia, Rept. 83 Meet. British Assoc. Advance. Sc. Birmingham, 1913, p. 532.
13. — 1914. The Cheirotherium. *Geol. Mag.*, Dec. VI, Vol. I, No. 603, pp. 395-398.
14. Williston, S. W. 1913. The Primitive Structure of the Mandible in Amphibians and Reptiles. *Journ. Geol.*, Vol. 21, No. 7, pp. 625-627, 1 fig. See also same author further notes: *Journ. Geol.*, Vol. XXII, No. 4, pp. 410-419, Figs. 13-19.
15. Wiman, Carl. 1913. Über das Hinterhaupt der Labyrinthodonten. *Bull. of the Geol. Instit. of Upsala*, Vol. XII, pp. 1-7, Figs. 1-8.
16. — 1914. Über die Stegocephalen aus der Trias Spitzbergens. *Bull. of the Geol. Instit. of Upsala*, Vol. XIII, pp. 1-30, Pls. I-IX, Figs. 1-10, bibliography.